Format:

Degree	Course number and title (language used for programming assignments if any)	Grade Points	Resources used
Topics covered			

and

Self-Study	Resources used

Note: For my B.Tech degree, the grade points are out of 10. Please see the back of the transcript for a detailed scale.

1. **Ordinary differential equations**

B.Tech	MA102 Mathematics II - Single and Multivariable Calculus and ODE	9	E. A. Coddington, An Introduction to Ordinary Differential Equations.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA102#MA102			

2. **Linear algebra**

B.Tech	MA101 Mathematics I - Linear Algebra and an Introduction to Basic Calculus and Real Analysis	10	- D. Poole, Linear Algebra: A Modern Introduction. - G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996. - R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Edn., Wiley India, 2005.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA101#MA101			

Self-Study	G. Strang, Linear Algebra and its Applications.

3. **Numerical analysis, scientific computing**

B.Tech	MA322 Scientific Computing (Matlab)	10	D. Kincaid and W. Cheney, Numerical Analysis: Mathematics of Scientific Computing.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA322#MA322			

MS	MATH 274 Numerical Methods /Physical Modelling (Matlab)	A+	R. L. Burden, J. D. Faires and A. M. Burden, Numerical Analysis.
Floating point arithmetic, direct and iterative solution of linear equations, iterative solution of nonlinear equations, optimization, approximation theory, interpolation, quadrature, numerical methods for initial and boundary value problems in ordinary differential equations.			

4. Computer programming

B.Tech	CS101 Introduction to Computing (C)	9	A. Kelly and I. Pohl, A Book on C.
https://www.iitg.ac.in/cse/csecourses/?courseCode=CS101			
B.Tech	CS110 Computing Lab (C)	10	
Programming assignments in C.			
B.Tech	MA252 Data Structures and Algorithms	10	T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, Introduction to Algorithms.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA252#MA252			
B.Tech	MA253 Data Structures Lab with OOP (C++)	10	
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA253#MA253			
B.Tech	MA451 Parallel Computing (CUDA, C++ multithreading, MPI, OpenMP)	10	J. JáJá, An Introduction to Parallel Algorithms.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=electives_btech#MA513 The course number has been updated by the department from MA451 to MA513.			
B.Tech	MA226 Monte Carlo Simulation (R)	10	See item 7.
B.Tech	MA322 Scientific Computing (Matlab)	10	See item 3.
B.Tech	MA471 Statistical Analysis of Financial Data (R)	10	See item 7.
B.Tech	MA691 Statistical Simulation and Data Analysis (R)	10	See item 7.

Self-study	Introduction to Parallel programming in CUDA by Nvidia at Udacity.com https://developer.nvidia.com/udacity-cs344-intro-parallel-programming[1]

5. Partial differential equations

B.Tech	MA201 Mathematics III - PDE and Complex variables	10	I. N. Sneddon, Elements of Partial Differential Equations.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA201#MA201			

6. Complex variables

B.Tech	MA201 Mathematics III - PDE and Complex variables	10	J. W. Brown and R. V. Churchill, Complex Variables and Applications.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA201#MA201			

Self-study	T. Needham, Visual Complex Analysis.

7. Probability and Statistics

B.Tech	MA225 Probability Theory and Random Processes	9	S. Ross, A First Course in Probability. J. Medhi, Stochastic Processes.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA225#MA225			
B.Tech	MA226 Monte Carlo Simulation in R	10	P. Glasserman, Monte Carlo Methods in Financial Engineering, Springer, 2004.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA226#MA226			
B.Tech	MA471 Statistical Analysis of Financial Data (R)	10	D. Ruppert, Statistics and Finance: An Introduction.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA471#MA471			
B.Tech	MA691 Statistical Simulation and Data Analysis (R)	10	C. M. Bishop, Pattern Recognition and Machine Learning.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=electives_btech#MA691 The department has updated the course name to Advanced Statistical Algorithms.			

[1] Link to certificate: https://drive.google.com/file/d/1zZLW797og5CgefYoij0TciFjICPkm00n/view?usp=sharing

MS	MATH 285 Stochastic Processes	A+	Notes by Prof. Ruth Williams at UC San Diego.
http://www.math.ucsd.edu/~williams/courses/past/math285-s19.html			
MS	CSE 250A Probabilistic Reasoning and Learning	A+	Notes by Prof. Lawrence Saul at UC San Diego.
http://cseweb.ucsd.edu/classes/fa20/cse250A-a/			

Self-study	S. M. Ross, Stochastic Processes.
Self-study	G. Casella and R. L. Berger, Statistical Inference.
Self-study	K. P. Murphy, Machine Learning: a Probabilistic Perspective.

8. Advanced Calculus/Real Analysis

B.Tech	MA102 Mathematics II - Single and Multivariable Calculus and ODE	9	G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA102#MA102			
B.Tech	MA224 Real Analysis	8	J. E. Marsden and M. J. Hoffman, Elementary Classical Analysis, 2nd Ed., W. H. Freeman, 1993.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=MA224#MA224 **Please note:** The content of this course was covered under two topics: (a) metrics and norms (b) Lebesgue measure and integral. At the time, I was not able to build a good intuition in (b) due to which I did not perform well in the second half of the course. However, through various courses including Math 190, 191 and 285 at UC San Diego (please refer to the transcript) and self-study, I have gained enough confidence in the material and I feel comfortable solving related problems.			

9. Graph Theory

B.Tech	MA421 Graph Theory	10	J. A. Bondy and U. S. R. Murty, Graph Theory with Applications.
https://www.iitg.ac.in/maths/acads/btech_struct.php?id=electives_btech#MA502 The course number has been updated by the department from MA421 to MA502.			

10. Differential Geometry

MS	MATH 150A Differential Geometry	A+	J. Oprea, Differential Geometry and its Applications. Notes by Prof. Jeffrey Rabin at UC San Diego.
MS	MATH 150B Calculus on Manifolds	A+	Same as above.
The two courses covered the following topics: Differential geometry of curves and surfaces, Gauss and mean curvatures, geodesics, parallel displacement, Holonomy, Gauss-Bonnet theorem, Covariant Derivative, Christoffel Symbols, glimpse at higher dimensions, application in General Relativity.			

11. Nonlinear Optimization

MS	MATH 171B Introduction to Numerical Optimization / Nonlinear	A+	Notes by Prof. Phillip Gill at UC San Diego.
Geometry of nonlinear programming, optimality conditions, the method of steepest descent, Newton's method, penalty function methods, augmented Lagrangian methods, interior methods.			

12. Convex Optimization

MS	MATH 245A Convex Analysis and Optimization I	A	Notes by Prof. Jiawang Nie at UC San Diego.
MS	MATH 245B Convex Analysis and Optimization II	A	Same as above.
The two courses covered the following topics: Basic theory of convex sets and convex functions, Lagrange duality theory, basic properties of convex optimization problems (linear, quadratic, semidefinite), applications and computational methods for convex optimization.			

13. Quantum Mechanics

MS	PHYS 212A Quantum Mechanics I	A+	Notes by Prof. Yi-Zhuang You at UC San Diego.
MS	PHYS 212B Quantum Mechanics II	A	Same as above.

Qubits and Entanglement: states, observables, time evolution, measurement postulate, uncertainty relation, density matrix, pure and mixed state, composition of quantum systems, entanglement entropy and mutual information, Bell inequality, tensor network, quantum circuit, quantum decoherence, quantum error correction.

Path Integral and Wave Mechanics: path integral, wave function, Schrödinger equation, position and momentum, Fourier transform, symmetry and conservation laws, quantum planar rotor, energy level, density of states.

Algebraic Methods: harmonic oscillator, creation and annihilation operator, boson number operator, coherent state, angular momentum theory, SO(3) rotational symmetry, fusion category of spins, hydrogen atom and SO(4) symmetry